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MORTALITY FROM PULMONARY TUBERCULOSIS IN RECENT YEARS.[1]

1. The Variation in Its Course During the War and Its Decline Since 1918.

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The course of mortality from pulmonary tuberculosis in the United States during and since the World War becomes clearer since the official statistics for 1920 and provisional data for 1921 and the first four months of 1922 have become available.

The extraordinary decline in the death rate from this disease since 1918 has been the subject of a good deal of speculation and the occasion of much rejoicing. The yearly rates for 1918, 1919, and 1920 from the United States Census Bureau and for 1921 from provisional data supplied the United States Public Health Service by the State health departments are shown for 24 States in Table I.

TABLE I.—*Mortality from pulmonary tuberculosis in 24 States, by years, 1918–1921.*

State.	Annual rate per 100,000.			
	1918	1919	1920	1921 [a]
California	168	156	142	133
Colorado	230	201	212	165
Connecticut	132	110	104	83
Delaware	(b)	153	132	118
Florida	(b)	99	96	86
Indiana	120	98	93	76
Kansas	53	45	41	37
Kentucky	179	146	134	110
Louisiana	176	135	133	113
Maine	98	85	85	65
Maryland	189	149	132	117
Massachusetts	138	110	97	84
Michigan	88	74	72	60
Minnesota	90	82	77	65
Mississippi	(b)	130	133	101
New York	149	125	106	88
Oregon	74	74	74	59
Pennsylvania	134	104	91	79
South Carolina	137	127	112	82
Tennessee	186	151	145	125
Vermont	88	75	67	56
Virginia	168	136	130	119
Washington	87	84	82	64
Wisconsin	82	73	74	64

[a] Provisional data.
[b] Not in registration area.
[1] From the Statistical Office, Field Investigations, United States Public Health Service.

But the decrease during the past four years can not be considered as a fact of significance unless it is viewed against the background of previous experience and in relation to possible conditions of an unusual or temporary character. A decrease during a relatively short period first must be established as a significant variation among the different kinds of variations that occur in a continuous series of death rates covering a much longer period. If, after allowing for possible changes in diagnosis and classification of causes of death, it is shown to be a significant variation, then it properly may be analyzed for the purpose of evaluating as far as practicable the effect of various factors.

From this point of view, a brief consideration is given in the following pages to the course of mortality from pulmonary tuberculosis in the United States in recent years in order to describe as accurately as possible what this course has been. A later paper will deal with the changes that have occurred in the death rate from this disease among persons of different sexes and ages, with special reference to the period during which epidemics of influenza occurred.

In the first place, it may be pointed out that a distinct "wave" of unusual magnitude in mortality from pulmonary tuberculosis occurred in this country during the past seven or eight years.[2] The fact that such a wave occurred at once suggests that at least part of the rapid decline since 1918 may have been simply the return to a normal level or, to put it more exactly, to the line of the trend as determined by the experience of previous years. To determine this point, it is necessary to ascertain what this trend has been and what the course of mortality from the disease would have been had the same trend been maintained.

The mortality records for Massachusetts are the best for this purpose, since they are available for a longer period than are those for any other State. In Table II the pulmonary tuberculosis death rates, as abstracted from the Massachusetts registration reports, are shown by years from 1857 to 1921, inclusive, a period of 64 years:

[2] The occurrence of such a variation in the pulmonary tuberculosis death rate was suggested in a previous article from this office (Note on the Course of Pulmonary Tuberculosis Mortality since 1914. Public Health Reports, May 27, 1921, 36: 1178–1183) in which it was observed that (1) the more or less steady decline prior to the war was interrupted by a definite rise, which was widespread and lasted through 1918, followed by a marked decline in 1919 and 1920; (2) the high rate for 1918 apparently was due to the two waves of epidemic influenza, and the rate for 1920 was probably somewhat increased by the 1920 epidemic influenza wave; and (3) roughly discounting the effect of the influenza epidemic, the existence of an unusual wave of mortality from pulmonary tuberculosis is still clearly shown, beginning in 1916, reaching its crest in 1917, and declining in 1918, 1919, and 1920.

TABLE II.—*Mortality from pulmonary tuberculosis in Massachusetts, by years, 1857–1921.*[a]

Year.	Annual rate per 100,000.	Year.	Annual rate per 100,000.	Year.	Annual rate per 100,000.	Year.	Annual rate per 100,000.
1857	395.0	1874	328.0	1891	239.6	1908	137.4
1858	384.2	1875	347.4	1892	244.8	1909	132.8
1859	388.6	1876	317.6	1893	231.0	1910	133.2
1860	370.2	1877	320.4	1894	223.4	1911	128.2
1861	365.2	1878	308.4	1895	223.4	1912	119.9
1862	342.8	1879	297.4	1896	216.4	1913	116.8
1863	372.6	1880	308.1	1897	207.4	1914	114.5
1864	375.7	1881	324.5	1898	197.4	1915	113.3
1865	367.9	1882	317.9	1899	190.4	1916	121.2
1866	353.0	1883	316.0	1900	185.3	1917	121.1
1867	325.5	1884	303.6	1901	176.7	1918	132.5
1868	322.0	1885	306.6	1902	162.1	1919	110.0
1869	328.8	1886	295.1	1903	154.7	1920	97.3
1870	343.3	1887	285.6	1904	164.1	1921	84.2
1871	339.3	1888	270.8	1905	155.9		
1872	362.6	1889	256.5	1906	149.2		
1873	353.6	1890	258.6	1907	150.9		

[a] Rates as published in Massachusetts registration reports. These rates differ slightly from those published by the U. S. Census Bureau for the years for which both sources of data are available.

In Figure 1 the yearly Massachusetts data are shown graphically. A logarithmic ordinate scale has been employed to permit a study of the *rate* of decrease or increase. It will be kept in mind that a straight line on such a scale indicates that a constant rate of rise or fall is being maintained.

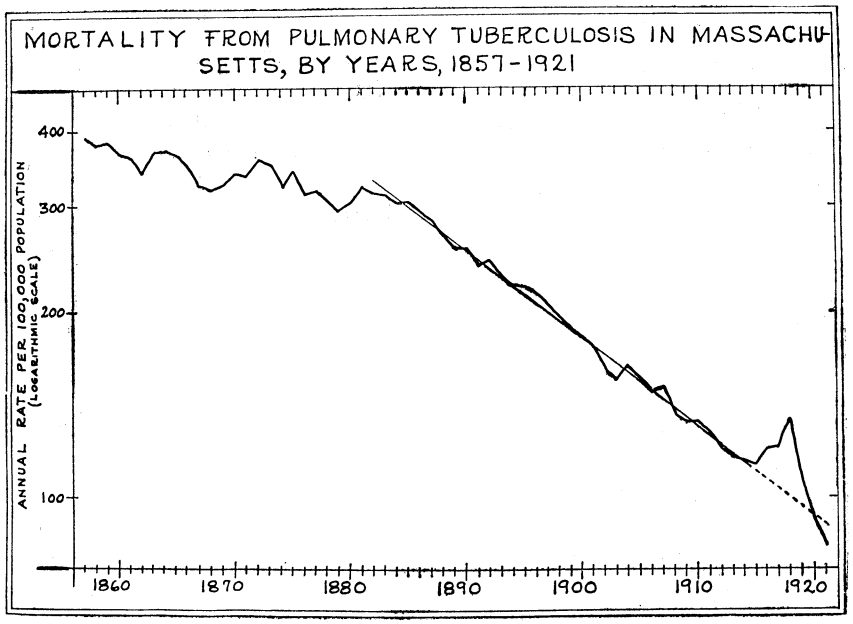
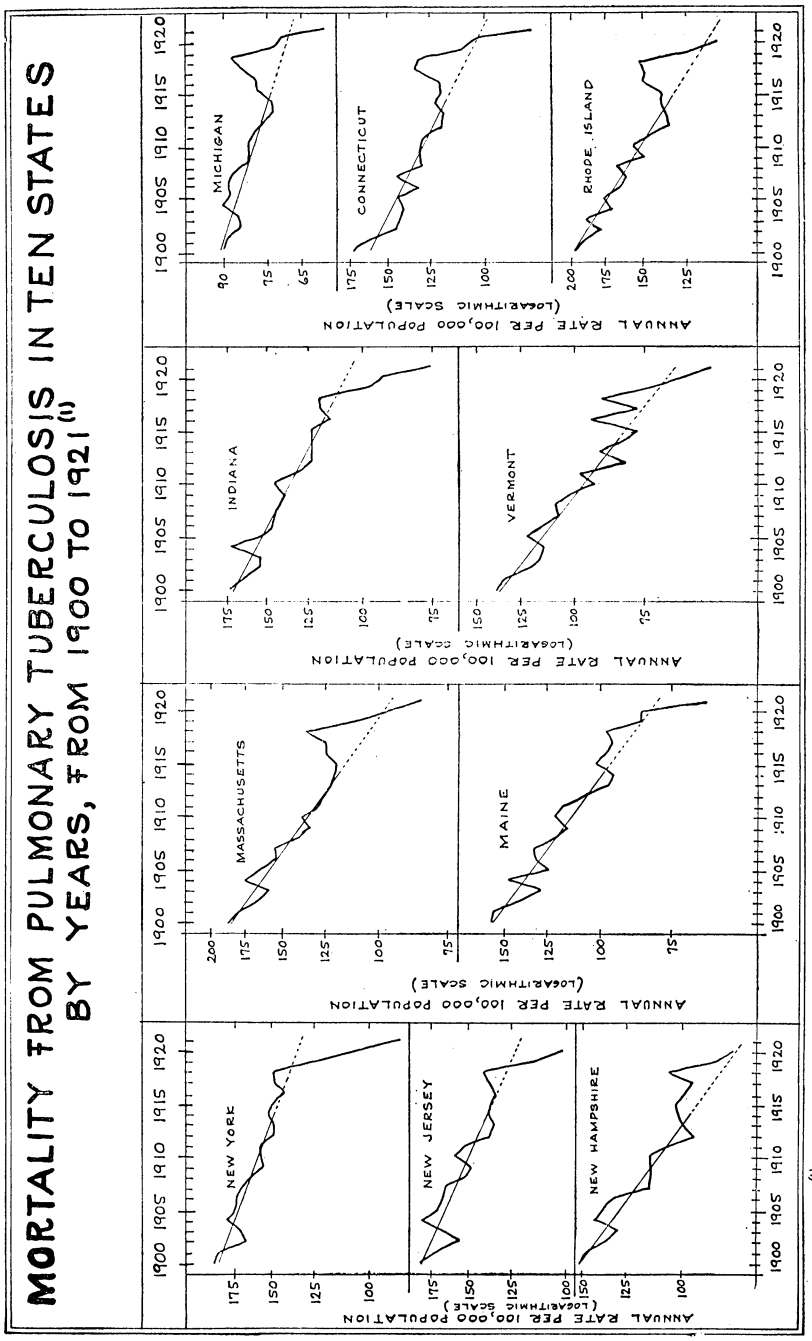


FIG. 1.

The curve for pulmonary tuberculosis mortality in Massachusetts, drawn on such a scale, challenges attention. Previous to about 1882 or 1883 there occurred, apparently, periodic variations of considerable length and magnitude about a trend which was slightly downward. Since then and until 1914 these periodic variations have been very much smaller and the decrease has been much more accelerated. If we fit a straight line to the period 1883–1914, as has been done in Figure 1 by inspection, it becomes quite clear that the same rate of decline, except for relatively slight variations, was maintained during the whole period of 30 years. Against such a background the changes in the rate during the past seven years are striking indeed. No such variation has occurred since 1880, and it is evident that the recent variation is of greater magnitude, considered in relation to the length of the cycle or period of variation, than any other in the entire period for which continuous mortality records are available in Massachusetts.

The further fact is equally evident that if we extend the straight line which was fitted to the rates for 1883–1914 through 1921 (see dotted line in fig. 1), we find that the rate for 1920 was practically on this line and the rate for 1921 not very far under it. In other words, for Massachusetts at least it is clearly suggested that in 1921 the death rate from pulmonary tuberculosis was not very much below what it would have been had there been no "wave" of mortality in the period 1915–1920.

But while Massachusetts affords in this instance an excellent illustration of the possibility of drawing an erroneous conclusion from changes in the death rate—especially when an encouraging drop occurs—unless sufficient attention is given to the trend over a period of considerable length, the course of mortality from pulmonary tuberculosis in one State can not be assumed to be representative of what happened in other sections of the country. Unfortunately, we do not have available similar records for other States over nearly so long a period, but it is possible to utilize the records for the period 1900–1920 and provisional data for 1921 for the 10 "original" registration States. The yearly rates are given in Table III and are plotted in Figure 2 on logarithmic ordinate scales of the same magnitude.



(1) RATES FOR 1921 PROVISIONAL.

FIG. 2.

TABLE III.—*Mortality from pulmonary tuberculosis in 10 "original" States, by years, 1900–1921.*

State.	Annual rate per 100,000.										
	1900	1901	1902	1903	1904	1905	1906	1907	1908	1909	1910
Connecticut	173.1	162.2	145.4	143.2	141.1	144.1	132.6	144.9	129.6	130.7	131.1
Indiana	173.2	164.1	153.9	153.6	172.9	152.3	145.6	145.2	142.2	138.6	144.9
Maine	157.4	155.1	138.8	128.3	146.2	123.2	130.1	132.3	119.7	114.3	120.9
Massachusetts	188.0	179.0	166.4	158.3	173.6	163.1	153.3	153.6	140.4	134.0	137.6
Michigan	90.2	88.4	84.1	85.3	91.3	87.6	88.6	85.5	82.3	80.7	82.4
New Hampshire	151.1	147.0	135.5	129.6	142.1	137.4	132.1	114.1	112.6	112.8	113.9
New Jersey	184.0	171.7	157.1	169.3	181.6	170.7	168.4	165.9	154.1	148.5	158.9
New York	191.1	186.8	166.8	170.7	179.7	173.7	173.8	169.0	164.3	155.4	158.2
Rhode Island	196.9	192.1	178.8	189.6	170.5	175.6	165.0	161.6	167.8	150.1	156.8
Vermont	138.2	133.9	119.6	114.8	114.4	122.0	113.3	103.7	108.3	100.9	92.1

State.	Annual rate per 100,000.										
	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	[1] 1921
Connecticut	126.8	120.0	118.9	123.2	119.5	121.3	134.3	131.8	103.8	103.8	83.4
Indiana	131.1	123.9	124.3	124.0	121.8	114.3	119.9	120.4	97.7	92.9	76.0
Maine	117.0	107.1	97.1	95.4	102.0	97.7	95.3	98.3	84.9	85.1	64.5
Massachusetts	130.3	126.1	121.5	119.8	119.3	125.0	125.3	138.1	109.8	93.9	84.1
Michigan	79.9	77.3	73.5	74.3	78.2	78.7	83.6	88.2	73.6	72.0	60.0
New Hampshire	104.8	95.1	99.4	100.5	102.0	97.8	95.0	107.7	86.6	81.4	.....
New Jersey	152.6	137.1	134.6	137.7	136.9	133.6	137.8	141.2	114.2	102.0	.....
New York	156.6	148.8	148.7	151.9	148.6	142.0	157.6	148.9	124.6	103.1	87.9
Rhode Island	147.2	135.1	137.3	139.8	138.9	150.8	150.4	153.3	124.9	110.6	.....
Vermont	97.6	81.4	89.6	82.1	76.5	93.0	76.7	88.7	75.4	67.0	56.6

[1] Provisional data.

In order to determine as nearly exactly as possible the trend of mortality from pulmonary tuberculosis in each State, straight lines were fitted to the rates for the period 1900–1914, inclusive.[3] Since a straight line fits the data very well in each instance it may be assumed to represent the trend of mortality fairly accurately for the period for which calculated. The trends are indicated by straight lines for 1900–1914, and their extensions beyond 1914 by dotted lines.

It is evident that the curves for the various States differ considerably with respect to the positions of the rates for 1920 and 1921 in relation to the trend during the period 1900–1914. For the seven States for which 1921 provisional rates are available, the 1921 rates are below the extended trend lines; that is, the 1921 rates are lower

[3] Straight in case of logarithmic scales. The formula for the line is $y=ab^x$, or, expressed in logarithmic form, $\log y=\log a+x \log b$. This is, of course, in the form of the equation for any straight line. If, then, straight lines are fitted to the logarithms of the rates in Table III, the antilogs of the derived constants $\log a$ and $\log b$ can be used in the equation $y=ab^x$. If an odd number of terms is used and x is taken as zero at 1907, the constants can be determined readily from the formulæ:

$$\log a=\frac{S \log y}{n};\ \log b=\frac{S\, x \log y}{Sx^2}.$$

It may be suggested to those not familiar with the procedure that the only difficulty which will arise will be in regard to the sign of $\log b$. In case of a curve sloping down toward the right it will be minus. That does not mean that the logarithm is minus, but that the equation must be put in the form $\log y=\log a-x \log b$, or, in the case of the antilog equation, $y=\frac{a}{b^x}$. In this case, on the left side of $x=0$, a will be multiplied by b; on the right side it will be divided by b.

than they would have been had the trend during 1900–1914 been maintained. Without attempting to calculate the probabilities, it is quite evident that most of these deviations are significant, as well as the deviation for 1920 in New Jersey. The percentage of decrease in 1921 over 1920 may be compared with the annual average and maximum percentage of decrease in the period 1900–1914 for each of the seven States, as in Table IV.

TABLE IV.—*Average yearly rate of decline of mortality from pulmonary tuberculosis from 1900 to 1914 compared with rate of decline in 1921 over 1920 in certain States.*[1]

State.	Percentage of decline.		
	1900–1914		1921 over 1920.
	Average per year.[2]	Maximum.	
Connecticut	2.2	10.5	19.6
Indiana	2.3	12.1	18.2
Maine	3.2	15.8	24.2
Massachusetts	3.2	9.1	13.2
Michigan	1.3	5.7	16.7
New York	1.6	10.7	17.2
Vermont	3.5	17.3	15.5

[1] Shown for States for which data from 1900 to 1921, inclusive, are available. The average rates of decline for the three additional States in Table III were: New Hampshire, 3.3; New Jersey, 1.9; Rhode Island, 2.7.
[2] Constant *b* of equations for straight lines which are plotted in Fig. 2.

If the 10 States be considered as a single population group, not only is there shown a marked decline from 1918 in the 1919 and 1920 rates, but the 1920 rate is definitely under a trend line that has been fitted to the 1900–1914 rates. The rates, the trend, and the deviations therefrom for the 10 States as a group in the period 1900–1920 are shown in the following table:

TABLE V.—*Yearly deviations from the trend of mortality from pulmonary tuberculosis in 10 "original" registration States, 1900–1920.*

Year.	Rate per 100,000.			Year.	Rate per 100,000.		
	Yearly.	Trend.[1]	Yearly deviations from trend.		Yearly.	Trend.[1]	Yearly deviations from trend.
1900	171.6	167.5	4.1	1911	135.7	134.7	1.0
1901	165.5	164.2	1.3	1912	127.9	132.1	−4.2
1902	151.0	161.0	−10.0	1913	126.3	129.5	−3.2
1903	152.3	157.8	−5.5	1914	127.8	126.9	.9
1904	162.5	154.7	7.8	1915	126.5	*124.4*	2.1
1905	154.0	151.7	2.3	1916	124.0	*122.0*	2.0
1906	151.4	148.7	2.7	1917	128.0	*119.6*	8.4
1907	149.3	145.8	3.5	1918	130.7	*117.3*	13.4
1908	142.7	142.9	−.2	1919	108.6	*115.0*	−6.4
1909	137.0	140.1	−3.1	1920	96.9	*112.7*	−15.8
1910	140.7	137.4	3.3				

[1] Determined by fitting a straight line on logarithmic scale to the yearly rates during the period 1900–1914.

The 1921 rate for seven of these States, as suggested by the graphs in Figure 2, would be well below this trend line. While the rate for the combined States is heavily influenced by New York, with its large population and its very remarkable decline since 1918, there does not seem to be any reason to doubt the occurrence of an unusually rapid drop in the pulmonary tuberculosis death rate in the United States during the last two years. The yearly rates for

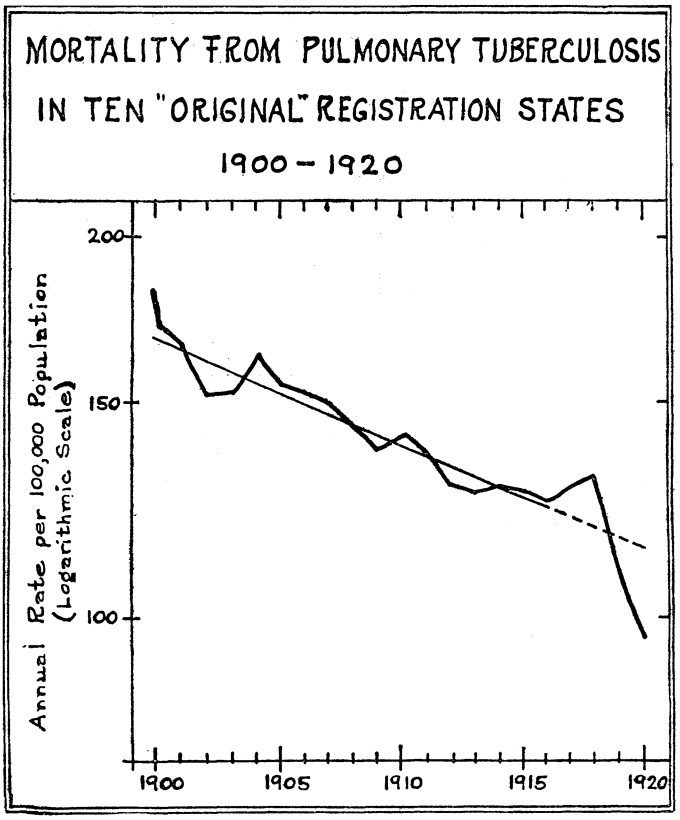


FIG. 3.

1900–1920, as well as the trend for 1900–1914 and its extension (dotted line), are plotted in Figure 3.

In order to describe this unusual wave more accurately, it is necessary to isolate the apparent or actual increase in mortality from pulmonary tuberculosis during the periods when influenza was epidemic. To ascertain, even approximately, the excess of deaths recorded as due to pulmonary tuberculosis over and above the mortality which properly may be considered as disassociated from the epidemics of influenza, it is necessary to use shorter intervals than years, since

each of the waves of epidemic influenza themselves lasted only a few weeks. Weekly data, however, are not available except for a limited number of cities, and recourse must be had to monthly records. The monthly rates are satisfactory for the purpose in view, since we do not wish to measure in exact terms how much excess appeared, but only to determine roughly the nature of the curve of the variation in those months in which epidemic influenza was absent. The annual death rates from pulmonary tuberculosis have been computed, therefore, for 24 States—as large an area as possible—for each month during the period 1915–1920, inclusive, and for 16 of the 24 States in 1921, as well as for Massachusetts. They are given in Tables VI and VII.

TABLE VI.—*Mortality from pulmonary tuberculosis in 24 States, by months, 1915–1921.*

Year.	Annual death rate per 100,000.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1915	129.6	138.9	150.6	148.7	136.3	122.5	115.6	106.5	104.0	104.7	110.1	120.0
1916	134.9	140.5	141.9	140.6	130.9	119.6	105.7	105.3	101.0	102.2	108.5	120.9
1917	136.5	145.2	149.2	145.2	138.9	121.4	115.2	106.3	108.4	106.0	110.7	118.0
1918	130.0	140.6	157.1	156.8	132.1	120.2	106.5	101.8	101.8	150.2	128.6	129.8
1919	142.3	142.2	139.3	135.0	123.1	109.8	104.2	95.6	87.5	88.9	91.2	99.0
1920	108.6	144.8	119.7	115.6	109.3	98.4	89.6	82.9	80.1	80.2	81.0	84.7
1921[1]	89.0	95.0	97.1	100.4	94.9	85.0	76.8	75.4	71.6	72.6	75.8	76.8

[1] Provisional data for 16 States out of the 24 considered in previous years.

TABLE VII.—*Mortality from pulmonary tuberculosis in Massachusetts, by months, 1915–1921.*

Year.	Annual death rate per 100,000.											
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov	Dec.
1915	126.9	135.5	137.0	137.9	125.0	127.5	111.7	101.9	108.0	101.9	114.1	106.1
1916	139.0	152.4	147.0	142.7	135.8	118.1	111.7	104.0	115.8	102.1	105.5	127.5
1917	131.7	142.4	150.1	143.0	139.6	121.4	119.7	109.3	107.1	101.1	118.5	119.1
1918	128.4	146.3	142.1	177.2	136.8	127.2	115.6	107.9	135.9	157.4	131.7	141.8
1919	150.7	134.9	142.1	127.2	119.1	103.6	102.8	93.5	85.2	81.8	87.1	91.4
1920	98.3	145.2	166.6	117.7	111.1	93.4	88.0	81.0	80.5	73.4	79.3	81.0
1921[1]	81.8	100.2	97.7	113.1	92.6	81.2	78.2	71.6	74.3	60.1	77.8	74.7

[1] Provisional data.

As soon as we use monthly data we introduce another variable, namely, season. Because of the obscuring effect of the normal seasonal variation, the monthly rates (as will be seen by glancing at the first graph in fig. 4) fail to show with any definiteness either the trend or the effect of the epidemic on them. It has been necessary, therefore, to eliminate this variation from the rates. The results for the 24 States and for Massachusetts alone are also shown in Figure 4. The rates plotted are the same as those given in the tables, except

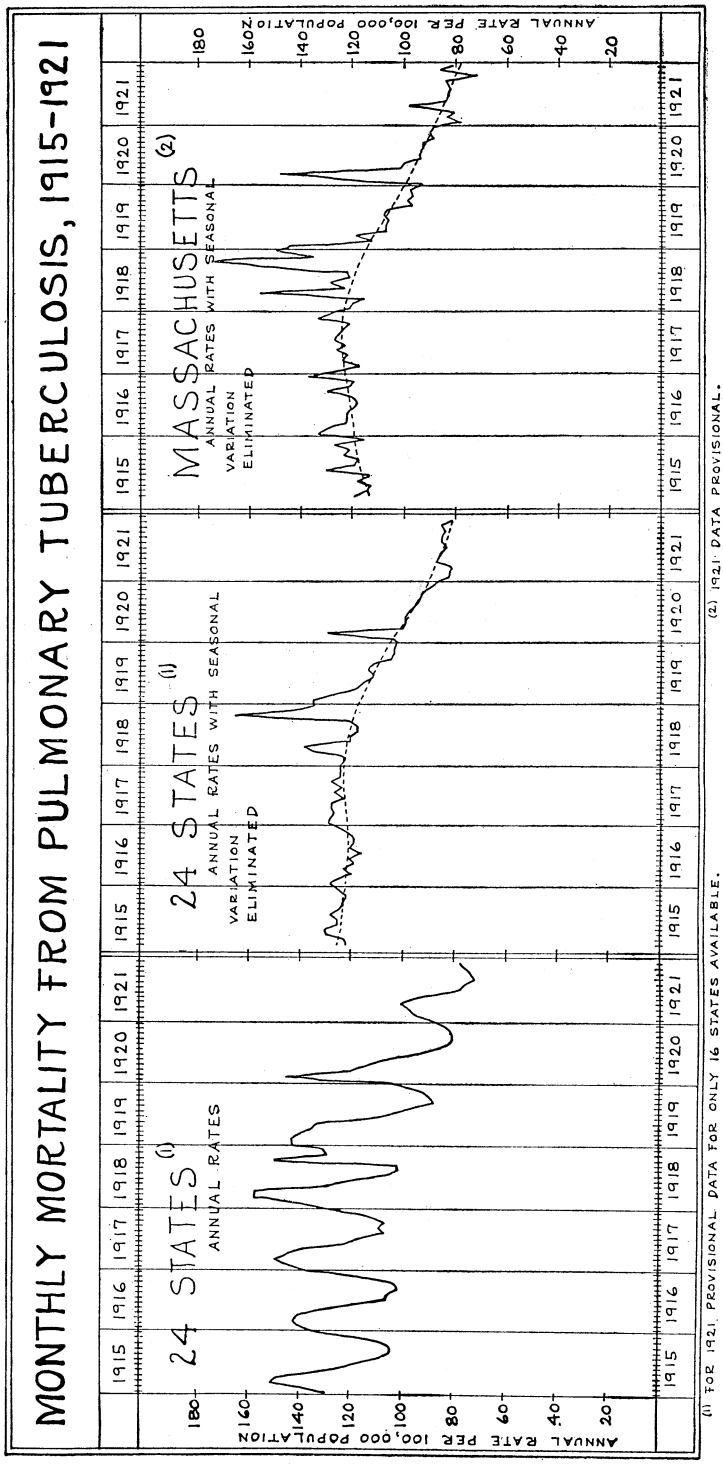

MONTHLY MORTALITY FROM PULMONARY TUBERCULOSIS, 1915-1921
24 STATES (1)
ANNUAL RATES
24 STATES (1)
ANNUAL RATES WITH SEASONAL VARIATION ELIMINATED
MASSACHUSETTS (2)
ANNUAL RATES WITH SEASONAL VARIATION ELIMINATED
ANNUAL RATE PER 100,000 POPULATION
1915
1916
1917
1918
1919
1920
1921
180
160
140
120
100
80
60
40
20
(1) FOR 1921, PROVISIONAL DATA FOR ONLY 16 STATES AVAILABLE.
(2) 1921 DATA PROVISIONAL.

FIG. 4.

that additions and subtractions have been made to eliminate the fluctuation due to season.[4]

The graph presents clear pictures, on the one hand, of the departures from the expected or "normal" mortality from pulmonary tuberculosis at different seasons of the year, and, on the other, of the variations in tuberculosis mortality disentangled from the epidemics of influenza. The high peaks in the spring of 1918, in the fall and winter of 1918–19, and in the spring of 1920 reflect in a striking manner the corresponding peaks of mortality from influenza-pneumonia, and there is even a suggestion of some correspondence between the tuberculosis and influenza-pneumonia mortality rates in 1915, 1916, and 1917.[5] A discussion of what this association actually means is beyond the limits of this paper, since we merely wish at this time to describe, with greater accuracy than we have done before, the recent variation in the death rate from pulmonary tuberculosis. But the variation itself is quite clear. Taking the 24 States as a unit, the rate ceased to decline in the early part of 1916 and began to increase in the latter part of the same year, rising until the beginning of 1918, and then began its marked decline, passing the trend line (if we may use that determined for the 10 original registration States for the period 1900–1914) in about the middle of 1919. For Massachusetts the wave began considerably earlier, quite definitely in 1915.

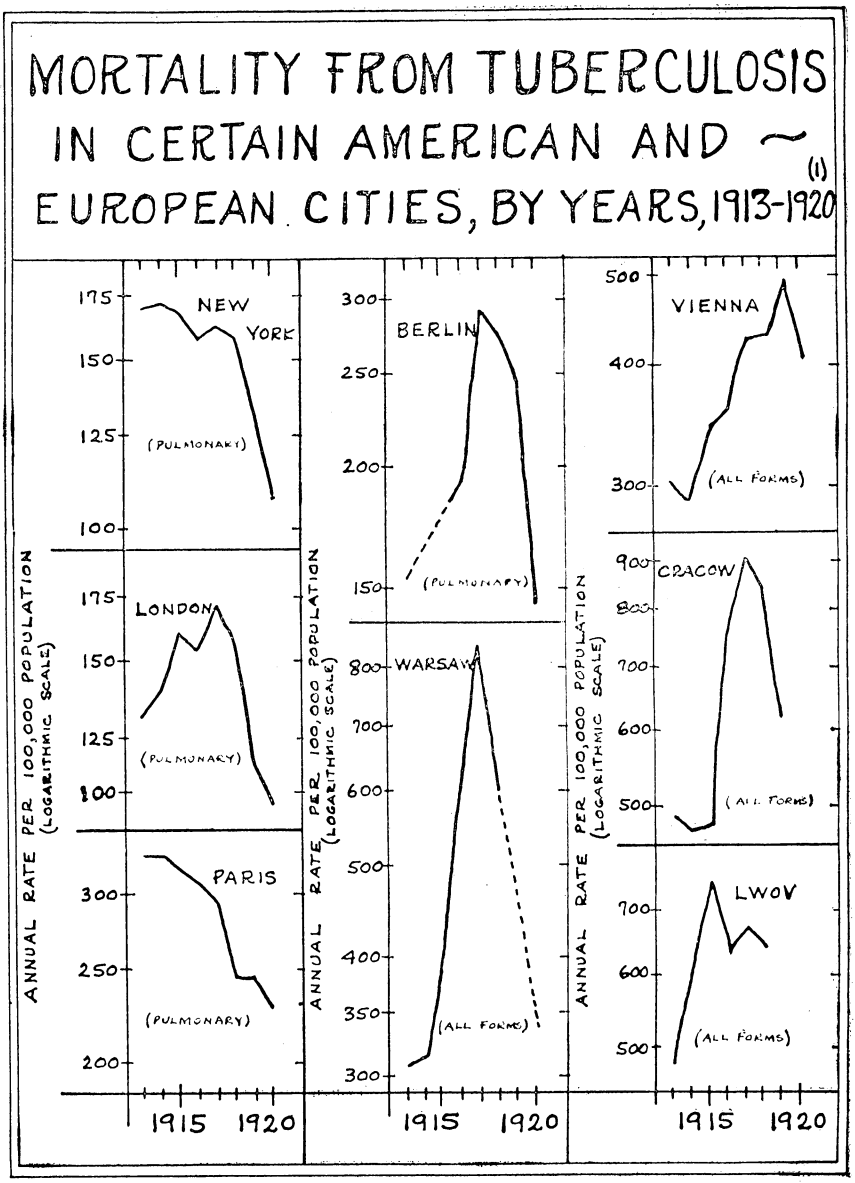
What were the conditions that gave rise to this variation, this wave of increased mortality from pulmonary tuberculosis which appears even after the effect of the influenza epidemics has been taken into account?

The question can not, of course, be answered by a study of the gross deaths alone. Possible factors may be suggested only. There can be no question as to the effect of conditions arising out of the war, upon the tuberculosis death rate in countries situated within the immediate field of war. One has only to glance at the curves as plotted in Figure 5 for some of the European cities to be impressed by the enormous variation in the rate.[6] The data are given

[4] The statistical procedure was to eliminate seasonal variation only and obtain values in terms of death rates that would exhibit the general trend, the cyclical variation (or "wave"), and the more significant deviations from them. A relatively simple graphical method was found to yield sufficiently exact results. The rates for each calendar month were plotted separately on semilogarithmic paper and from them the curve which best represented the trend and wave during the 7-year period was found. This curve was then fitted to the rates as plotted and a different set of values for each calendar month read off. The deviations of the rates from these values were next computed and added to the curve representing trend and "wave" as previously calculated. The resulting items were fairly close approximations to the pulmonary tuberculosis death rate by months with the seasonal fluctuations eliminated.

[5] So far as 1918, 1919, and 1920 are concerned, the time of occurrence of the epidemic peaks is well known. A discussion of the presence of distinct peaks in the three preceding years is given in a paper on "The Epidemiology of Influenza," by W. H. Frost, Reprint No. 550 from the Public Health Reports of August 15, 1919, vol. 34, No. 33, pp. 1823-1836.

[6] Attention may be called to a recent article on the increase of tuberculosis in Germany during the war: Kirchner, M.: Die Zunahme der Tuberkulose während des Welt-Krieges und ihre Gründe. Zeitschr, f. Tuberk., May, 1921, xxxiv, 228. The article is abstracted fully in the American Review of Tuberculosis, July, 1922: Abstracts of Tuberculosis, Vol. VI, Abst. No. 5, pp. 144-145.



[1] Rates taken from a table compiled by G. J. Drolet, statistician, New York Tuberculosis Association, and published in the bulletin of that association, Jan.-Feb., III, 7.

FIG. 5.

in Table VIII, which also compares the pulmonary tuberculosis death rate in England and Wales with that in 20 States of the United States.[7] (See fig. 6.)

TABLE VIII.—*Mortality from tuberculosis in the United States and in England and Wales, by years, 1910–1920, and in New York City and in certain European cities, by years, 1913–1920.*[1]

Place.	Form.	Annual death rate per 100,000.										
		1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
20 States of United States..	Pulmonary....	133	130	122	120	121	121	113	123	129	108	98
England and Wales.....	.....do.....	101	103	102	99	102	[2] 116	[2] 118	[2] 125	[2] 134	109	89
New York.....	.....do.....	.....	.....	.....	171	173	169	159	164	160	132	109
London.....	.....do.....	.....	.....	.....	130	133	[2] 160	[2] 153	[2] 171	[2] 159	117	106
Paris.....	.....do.....	.....	.....	.....	328	328	319	307	295	248	248	227
Berlin.....	.....do.....	.....	.....	.....	156	.....	.....	194	292	276	245	148
Vienna.....	All forms.....	.....	.....	.....	302	278	322	327	425	427	490	405
Warsaw.....	.....do.....	.....	.....	.....	303	312	410	601	840	592	.....	338
Lodz.....	.....do.....	.....	.....	.....	.....	.....	.....	.....	1,164	775	604	.....
Cracow.....	.....do.....	.....	.....	.....	487	473	480	750	908	845	616	.....
Lwov.....	.....do.....	.....	.....	.....	480	586	741	622	665	635	.....	.....

[1] Data taken in part from a table compiled by C. J. Drolet, statistician, N. Y. Tuberculosis Association, and published in the Bulletin of that association, January-February, 1922, iii: 7; in part from published reports of Registrar General of England and Wales, and of the Census Bureau of the United States.
[2] Civilian death rate only.

In England and Wales a marked rise in the rate began as early as 1914, reaching its peak in 1918, and falling rapidly to a low point in 1920. In the United States, while the rate was on a higher level before the war than in England and Wales, there was a quite definite rise in the latter part of 1916 (and in Massachusetts in 1915, as our monthly graphs have indicated), later than in England and Wales, but definitely before our entry into the war. In fact, the crest of the wave was passed in 1917 in this country, and the decline of the wave actually set in prior to the major peaks of the influenza epidemic. Its possible association with the extreme industrial depression which occurred in 1914 and 1915 has already been suggested.

In studying the course of the death rate from this as well as other nonepidemic diseases, however, one can not fail to recognize the fact, already referred to, that periodic variations or "waves" occur with more or less regularity. As a result, the epidemiologist, while having faith in the continued decline in the *trend* of tuberculosis, may seem pessimistic at the very times when the death rate is dropping most rapidly because he has learned to recognize the probability (based on past experience) that a marked acceleration of a decline will be followed by a period of arrested decline or of even increased mortality. Just as at least some of the recent decrease in the tuberculosis death rate properly might be considered as the descending limb of a curve which had its peak in 1917, so it is reason-

[7] The same area is maintained in the statistics for the whole period in order to render the data for the different years comparable.

able to conceive of the possibility that we are reaching the minimum rate of a cycle—the "trough" of a "wave."

There are already evidences of a very definite slowing up of the rapid decline in the tuberculosis death rate, and, in at least some localities, of an increase over the 1921 rate. In New York City, for example, the rate declined from 105.1 per 100,000 in April, 1920, to 84.2 for the same month in 1921, or nearly 20 per cent, whereas the

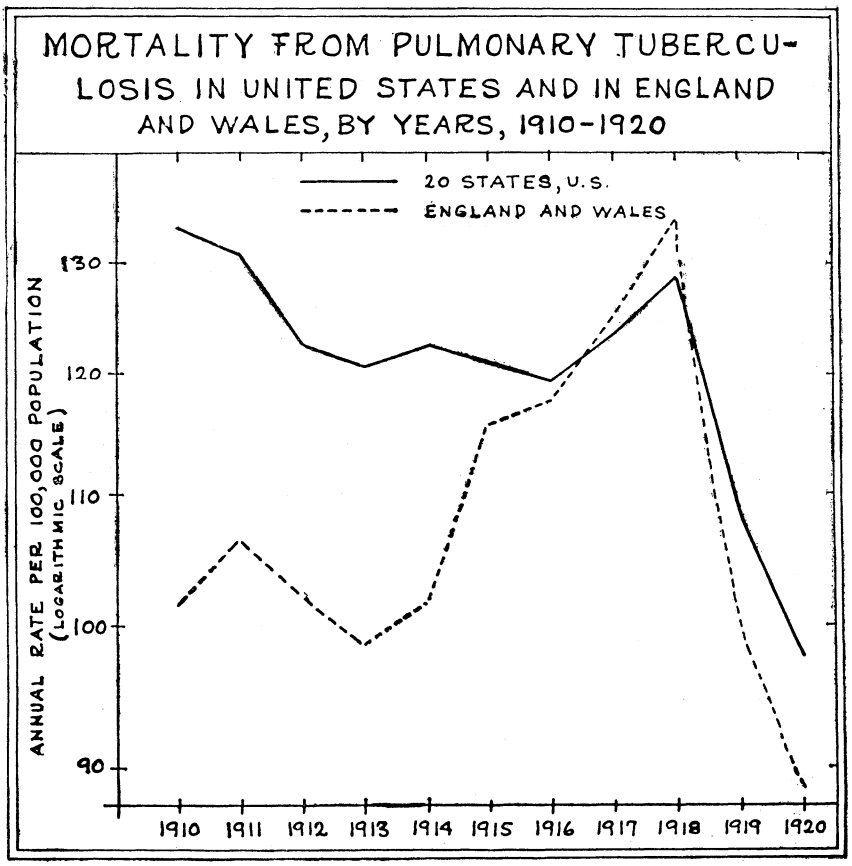


FIG. 6.

rate in April, 1922, was 82.5, a decline over 1921 of only about 2 per cent. In New York State, exclusive of New York City, the April rate declined from 95.5 in 1920 to 76.4 in 1921, or 20 per cent, while the April, 1922, rate was 85.4, an increase of over 10 per cent. The statistical bureau of the Metropolitan Life Insurance Co., in its June, 1922, bulletin, notes that "for the first time in many months the death rate for tuberculosis of the respiratory system shows a slight increase over the rate in the preceding year" among its policy-

holders. From preliminary figures supplied currently to the Public Health Service and published in the Public Health Reports, the annual death rate per 100,000 from all forms of tuberculosis (pulmonary not being given separately in these reports) has been computed for 23 of the largest cities in the United States during the period April 1–June 30, 1922, and for a corresponding period in 1921, as shown in Table IX.

TABLE IX.—*Mortality from tuberculosis (all forms) in 23 large cities of the United States during April, May, and June, 1921 and 1922.*

City.	Number of weeks for which reports were received.[1]	Annual death rate per 100,000.	
		1921	1922
Baltimore	10	201	250
Boston	12	386	373
Buffalo	11	275	220
Chicago	12	385	425
Cincinnati	11	320	224
Columbus	12	67	105
Detroit	12	239	251
Indianapolis	11	231	84
Jersey City	11	147	203
Kansas City, Mo	12	60	114
Milwaukee	12	190	162
Minneapolis	11	309	336
Newark	9	356	308
New Orleans	12	262	305
New York[2]	12	259	254
Philadelphia	11	211	202
Pittsburgh	8	181	153
Portland, Oreg	12	171	124
Rochester	9	279	338
St. Louis	11	293	260
San Francisco	11	284	272
Toledo	8	121	140
Washington	12	275	335

[1] Data for corresponding weeks only in the two years compared.
[2] Pulmonary only.

It will be noted that for 12 of the 23 cities the 1922 rate is actually higher than the 1921 rate, and that in at least four more the decline is negligible.

It would be hazardous to prophesy, however, simply upon the basis of the past behavior of figures. One can only point out that, judging from past experience and without attempting to give mathematical expression to the probability, a slowing up of the recent rapid decline of the pulmonary tuberculosis death rate or even the beginning of another upward variation is to be expected.

Whether or not a new trend has set in since 1917 is a question that can not be answered until a sufficient number of years has elapsed to permit proper allowance statistically for the periodic variations which, as we have seen, characterize the course of the disease.

SUMMARY.

1. A period of increased mortality from pulmonary tuberculosis is definitely indicated in the United States during the period 1915–1918. In some States, notably Massachusetts, this wave was quite marked and its magnitude exceeded previously recorded variations of a periodic nature when the trend is taken into account.

2. The rates for 1921 are so far below the trend line, as established by preceding years, in most of the States for which sufficient data are available and for the 10 "original" registration States as a whole, that the decline since 1919 or 1920 appears definitely to be unusual.

3. When the effect of the influenza epidemics in 1918–19 and 1920, in apparently or actually increasing the pulmonary tuberculosis death rate in those years, is taken into account, the wave of increased mortality is more accurately described as beginning in 1915 or 1916, reaching its crest in 1917, and beginning to decline well before the major influenza epidemics occurred. This "wave" occurred in European countries also, but began earlier than in the United States, reached a much greater magnitude, and subsided later. The possibility of an association between the "wave" as it appeared in the United States and the unfavorable economic conditions in 1914 and 1915 has been suggested.

4. Whether or not a new direction or trend of mortality from this disease began about 1918 can not be ascertained until a considerable period of years has elapsed and the magnitude of the shorter periodic variations has been determined.

5. There are indications that a low point has been temporarily reached in mortality from pulmonary tuberculosis in the United States and that either the recent rapid decline will be arrested or an actual increase—possibly another upward variation—will take place. In other words, we may be in the "trough" of a periodic "wave."

DEATHS DURING WEEK ENDED NOVEMBER 4, 1922.

Summary of information received by telegraph from industrial insurance companies for week ended November 4, 1922, and corresponding week 1921. (From the Weekly Health Index, November 7, 1922, issued by the Bureau of the Census, Department of Commerce.)

	Week ended Nov. 4, 1922.	Corresponding week 1921.
Policies in force	51,100,523	48,140,310
Number of death claims	8,367	7,921
Death claims per 1,000 policies in force, annual rate	8.5	8.6